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SCIENTIFIC AFFAIRS

No. 774

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CONTENTS

CZECHOSLOVAKIA

CMOS Integrated Circuit Technology Surveyed (Ladislav Suran, Rostislav Wasyluk; SDELOVACI TECHNIKA, No 1, 1983) 1

HUNGARY

Achievements of Computer Technology, Automation Research Institute (SZAMITASTECHNIKA, Jan 83) 10

Use, Production, Research on Robots (SZAMITASTECHNIKA, Jan 83) 12

Robots, Automation in GDR (R. Georgi; SZAMITASTECHNIKA, Jan 83) 16

Achievements of Bulgarian Electronics (Tamas Boromisza; SZAMITASTECHNIKA, Jan 83) 18

POLAND

Military Development of Laser Systems Described (POLISH TECHNICAL REVIEW, May-Jun 82) 23

Continuous-Wave Laser, by Zdzislaw Jankiewicz, et al.
YAG 50B Pulsed Laser, by Zdzislaw Jankiewicz, et al.
Low-Power He-Ne Laser Head, by Maksym Gebczak, Jerzy Tuszynski

Major Developments in Electronics Described
(POLISH TECHNICAL REVIEW, May-Jun 82) 29

HS-1 Holocamera, by Zdzislaw Jankiewicz, et al.
Microprocessor Bipolar Integrated Circuits, by Jacek Bay
by Jacek Baykowski, et al.

Scientific Community Criticizes Economic Reform
(Aleksander Kopec Interview, RZECZPOSPOLITA, 9 Feb 83) 35

CMOS INTEGRATED CIRCUIT TECHNOLOGY SURVEYED

Prague SDELOVACI TECHNIKA in Czech No 1, 1983 pp 17-19

[Article by Eng Ladislav Suran and Eng Rostislav Wasyluk, CSc: "Advantages of CMOS Technology in Integrated Circuits"]

[Text] This article describes the advantages and disadvantages of CMOS [complementary metal-oxide-semiconductor] technology compared with other integrated circuit technologies as regards energy consumption, operating speed, density of integration, and structure. It presents the specific characteristics of CMOS technology and trends in its development, as well as the current stage of development of this technology and the types of integrated circuits developed and produced in Czechoslovakia, and outlines developments planned for the next few years.

Introduction

CMOS circuits belong to the large group of unipolar integrated circuits made up of transistors, in which the current is carried by a single carrier type, either electrons or holes. The operating principle of these components is use of an electrical field to control the passage of carriers through the channel (the FET [field-effect transistor] principle), which is realized by a layered metal-oxide-semiconductor structure. CMOS circuits consist of series combinations of transistors with p-type and n-type channels, which has led to the name "complementary," borrowed from complementary combinations of npn and pnp transistors (see Figure 1). They are practically equivalent to a single transistor with a divided gate. If there is no AC signal at the input, then depending on the polarity of the power supply voltage, one of the channels is nonconducting, so that the "no-signal" voltage is minimal, in the nanoampere range, while the no-signal power consumption is in the vicinity of 10 nanowatts. Thus if there is a logical 1 or 0 at the input, the CMOS gate draws only a negligible amount of current. A greater current flows during change of state. Thus the CMOS gate does not draw a greater amount of energy from the power supply to store information than in the no-signal state, as is the case with other kinds of logic.

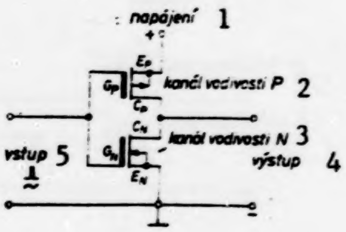


Figure 1. Basic interconnection of MOS transistors in CMOS configuration: an inverter gate. E, source; G, gate; C, drain.

Key:

1. Power supply
2. p channel
3. n channel
4. Output
5. Input

These properties of small-scale and large-scale integration (SSI, MSI) CMOS circuits make them the most-used type in applications circuits. They are suitable for use in all cases where minimum power consumption is required, when equipment is designed to operate for long periods with a backup power supply, and when heating of the system or device is undesirable.

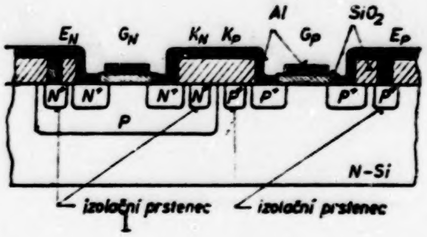


Figure 2. The inverter of Figure 1 in monolithic integration.

Key:

1. Isolating ring

A practical implementation of complementary transistors in monolithic integration is shown in Figure 2. P^+ and n^+ emitters and collectors are diffused into an n-type silicon substrate to produce the p-channel transistors and their isolating rings (right side of Figure 2), while p-type sources and drains are diffused for n-type channels. In the next step, the diffusion step, the sources, drains and isolating rings for the n-type channels are diffused into the p-type areas (left side of Figure 2). Hence there are three diffusion processes, as in the case of bipolar transistors. It is apparent from Figure 2 that the CMOS structure actually contains parasitic npn and pnp transistors at various locations in the structure. Lateral n^+pn or pnp^+ structures are the safest, since vertical npn^+ transistors are considerably limited by the relatively great depth of the diffused areas (base width). Therefore the necessary isolating rings are introduced with the same or opposite potential from the sources, or are made of insulating material to eliminate leakage and the formation of parasitic transistors.

Advantages and Disadvantages

As indicated by the basic description, CMOS gates should be ideal switching components, since they consume energy only during switching. However, as a result of charging and discharging of parasitic capacitances in the integrated structure, the energy consumption during switching increases linearly with frequency, so that the energy consumed at frequencies above 10 MHz begins to be the same as in ordinary MOS circuits with an aluminum gate. Thus the low no-signal power consumption is an advantage only for pulse trains at frequencies lower than 10 MHz in the aluminum gate technology. There are, however, methods of raising this frequency.

The fact that CMOS technology involves two transistors in the logical gate instead of one MOS transistor in the logical gates of other MOS technologies, and the fact that they require a protective ring for reliable operation, give CMOS about double the area of classical PMOS [p-type MOS] circuits. The price of the very low no-signal power consumption is a considerable increase in circuit area.

Producing the doped areas for transistors with an inverted channel involves one additional (diffusion) process, which results not only in loss of time during production, but also loss of energy and corresponding decreases in yield. This is another price that is paid for the low power consumption of the circuits.

On the other hand, we must not forget that even in rather large CMOS systems (such as memories) on a single chip, the chip need not be placed on a heat sink, to which it would have to be soldered according to the prescribed method, an operation which involves several complications for those who apply the circuits and threatens decreased reliability for the final consumer.

The arrangement of the transistors in the CMOS structure shown in Figure 1 allows a wide range of power supply voltages, generally from 5 to 15 V. This has, of course, many far-reaching advantages. First, the logical gates can be connected together in such a way that the circuit has only one power supply voltage. This eliminates the necessity for two power supplies or for voltage dividers. It is easy to achieve compatibility with other types of logic which work at higher power levels, such as TTL [transistor-transistor logic]. Reliable operation of CMOS circuits does not require a stabilizer stage, which is an advantage that saves money for the producer and offers improved reliability to the user. Another advantage of the wide range of power supply voltages in the design of CMOS circuits is their considerable noise immunity, which increases their reliability and their capability for processing analog signals. This means that they can be used to design analog-digital or digital-analog converters on the same chip as logic circuits (registers, switches, memories). Their particular design, for example the existence of p-type diffused areas, is very suitable for use in combined integration of bipolar peripheral systems (input-output circuits, interface circuits) and CMOS circuits on a single chip without an additional manufacturing step; this can be achieved simply by choosing suitable masks.

These advantages stemming from CMOS design result in their use in all cases when low power consumption, noise immunity, and the possibility of combining several unrelated types of logic on the same chip are required.

These advantages of CMOS circuitry are so great that the investment in further research and development aimed at moderating, bypassing or eliminating the disadvantages of the manufacturing process mentioned above, i.e., its technical difficulty (reproducibility of threshold voltages) and cost (additional diffusion of p-type source and drain) and its integration density are quite worthwhile. CMOS circuits are passing through various generations, which will be briefly surveyed below.

Development of CMOS Circuits

A number of improvements were incorporated in the second generation. The primary purpose of these improvements was to decrease power loss and thus to raise their working or limiting frequencies, while a secondary aim was to decrease the labor required to produce them. The improvements were based on the equation for AC power loss $P = CU^2f/2$, which shows the linear frequency dependence mentioned above and also that fact that at a constant rated voltage, requirements for higher frequencies and a strict linear relationship can be relaxed by decreasing the capacitance C, particularly the loss capacitance.

Thus the first group of second-generation innovations involved decreasing parasitic capacitances in the vicinity of the gate, while the second involved limiting the number of leaks between individual transistor systems in the circuit.

The capacitance is decreased by decreasing the dimensions of the entire transistor, by using the so-called silicon gate technology, or by using a new doping technique such as ion implantation. The essence of the silicon gate principle is that the gate oxide is not metalized with metal, but with polycrystalline silicon which is doped to make it conductive (conductivity of about 20-50 ohms/square in a film about 0.1 microns thick); in the aluminum gate technology the metalization is carried out with aluminum. Without going into technical detail, we note that the main advantage of the silicon gate is the low (theoretically zero) overlap of the gate electrodes with the diffusion region of the source and drain (compare figures 2 and 3), which considerably decreases parasitic overlap capacitances. This is achieved by applying the gate oxide layer and the polycrystalline layer through the same mask. This results in self-alignment between the oxide, its metalization and the edges of the previously diffused layers.

A second advantage of the silicon gate is that it simplifies the production technology and thus makes it more precise (giving a higher yield) compared with the metal gate technology. Also important is the fact that the polycrystalline silicon forms a second metalization level above the metal, which can be used to decrease the area of sealing of the all-metal metalization previously used.

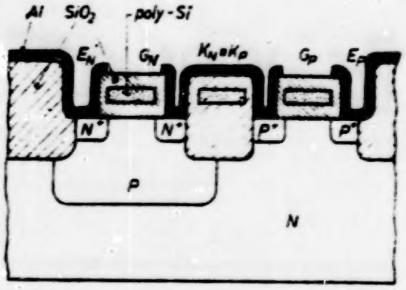


Figure 3. Oxide isolation of individual transistors in CMOS system.

Ion implantation is a new method of local doping which replaces diffusion. The selected dopant in gaseous form is ionized in the implantation chamber and the ions are introduced through windows into an accelerating electric field and a magnetic system which direct them against the masked silicon wafer. In the unmasked locations the dopant ions penetrate into the surface of the wafer, where, after annealing, they are largely incorporated into the silicon lattice, producing a certain concentration of dopant defects, just as in the case of diffusion. The main advantage of implantation compared with diffusion is that the implanted defect ions mostly penetrate into the substrate in a direction perpendicular to its surface, and thus there is minimal impact scattering followed by annealing, thus minimizing lateral penetration which would result in isotropic diffusion in all directions. Thus the gate electrode covering the doped regions is much smaller than in the case of diffusion, which along with the decrease resulting from self-alignment, results in decreased parasitic capacitance. Thus ion implantation is a simpler, more precise technology than diffusion, but the equipment is much more expensive than diffusion furnaces. The trend toward smaller and smaller dimensions in microelectronics is also leading to exclusive use of implantation.

Loss power and information processing accuracy are improved in the new generation by improving the isolation of the individual transistors. The original isolating loop, with simple p-n diode isolation, is replaced by a double-junction ring (p-n-p-n) (see Figure 2), and ultimately by a local oxidized ring, which not only is more effective in limiting parasitic currents between the various areas of the transistors than diode isolation (since it does not have an additional space charge region and cannot produce parasitic transistors and thyristors), but also simplifies implantation. These techniques (see Figure 3) are called "Isoplanar" or "Planox" by their producers are designated by the prefix "ISO-". All modern CMOS systems are manufactured by this technology.

Because of its fundamental advantages, CMOS technology has recently undergone several further innovations aimed at improving its advantages and minimizing its disadvantages. For reasons of space we mention only the most important.

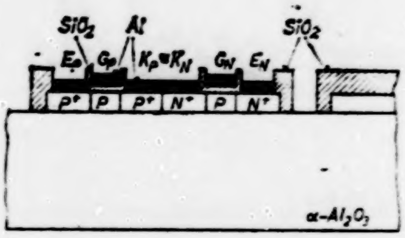


Figure 4. CMOS elements on sapphire. P below G_p is a depletion channel, and P+P+ is equivalent to PNP.

The attempt to limit parasitic transistors and leaks to the substrate has resulted in the use of sapphire as a substrate material instead of silicon (since it has a better isolating resistance 10^{15} ohm-cm). The elements are isolated from each other by applying an epitaxial layer to the substrate (see Figure 4). SOS [silicon on sapphire] CMOS thus allows a further decrease in power consumption and gate delay and increases isolation considerably compared with silicon CMOS. Thus an improvement in integrated circuit properties is purchased at the cost of a severalfold increase in the cost of the substrate material and an increase in labor inputs.

Some decrease in loss power and a certain increase in integration density have been achieved by ion implantation doping of the channels and oxide layers. These treatments also increase the reliability of circuit function. Speed is increased and gate loss power decreased by the common p drain technology, which has made it possible to approximately double the gate speed (gate delay about 20 ns) while decreasing area by about 5 percent. The common p drain technology also results in high immunity to alpha radiation.

Another very important innovation in CMOS technology is combined integration with bipolar or NMOS (n-type MOS) components on a single chip. This yields the benefit of lower loss power in the CMOS circuits and higher speed in the NMOS and bipolar circuits.

To date, the greatest use of CMOS circuits worldwide has been in clocks, wrist watches, calculators with LCD's [liquid crystal displays], telecommunications equipment, space and military equipment, and consumer electronics designed for portable energy sources.

Development of CMOS Technology in Czechoslovakia

Because of the advantages of CMOS technology, primarily its low power consumption and wide range of working voltages, in the second half of the 1970's a demand for its introduction in Czechoslovakia arose. The main purchasers of CMOS circuits were enterprises producing telecommunications equipment for automated electronic private branch exchanges and telephone equipment, enterprises producing communications equipment for portable radio stations, and enterprises producing timing devices for electronic alarm clocks.

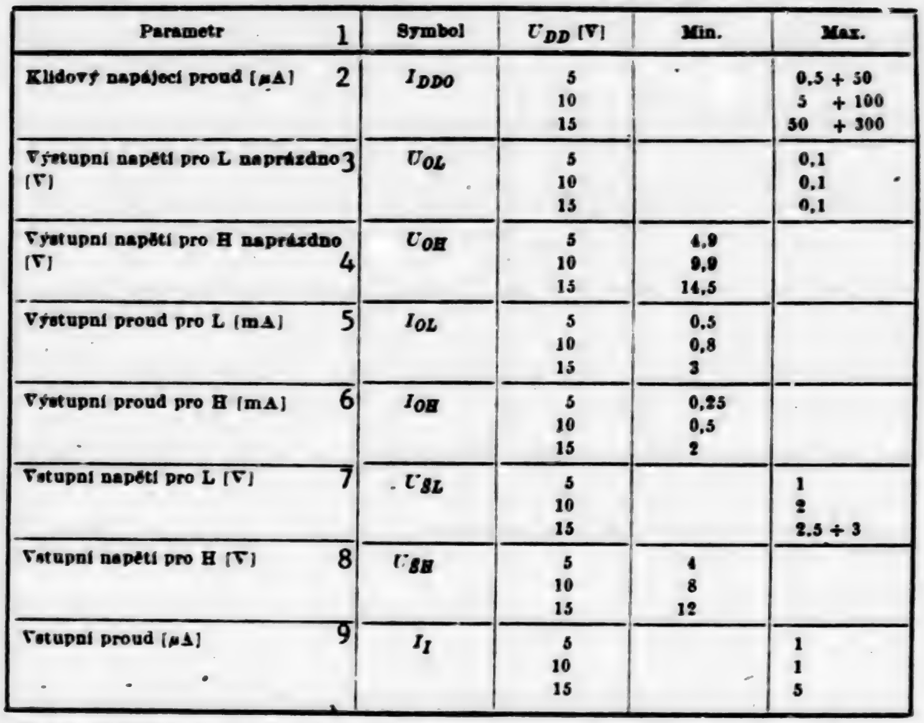
As a result, at the end of the 1970's the microelectronics department of TESLA VUST [Research Institute of Communications Technology] began to develop small SSI and MSI CMOS circuits. Since 1980 its development work has been proceeding within the context of State Assignment AZ 09-119-102 in cooperation with the TESLA Piestany k. p. [concern enterprise], which will continue to be the producer of all of the circuits mentioned in Table 1.

The 4000-series SSI and MSI circuits were also joined by large-scale integration (LSI) circuits with about 10^4 components per chip or a chip area of more than 20 mm^2. A survey of the circuits that have been developed and produced is given in Table 1. The main characteristics of 4000-series CMOS circuits are shown in Table 2.

Table 1. CMOS Circuits in Production or Being Prepared for Production in Czechoslovakia

Number	Type
4001	quad 2-input NOR gate
4002	dual 4-input NOR gate
4011	quad 2-input NAND gate
4012	dual 4-input NAND gate
4013	dual D-type flip-flop
4015	dual 4-bit static shift register
4020	14-state binary counter
4024	7-level counter
4029	linear 2-way decade counter
4030	quad EX-NOR gate
4046	phase lock circuit
4049	6 x putput interter gate
4050	6 x noninverting output stage
4051	8-channel analog multiplexer
4052	dual 4-channel analog multiplexer
4053	triple 2-channel analog multiplexer
4066	quad 2-way switch
4068	8-input NAND gate
4076	quad D-type flip-flop
4081	quad 2-input AND gate
4099	8-bit addressable accumulator
4311	7-segment decoder-driver with memory
4503	6 x bus driver
4518	dual BCD [binary coded decimal] counter
4555	dual 1-of-4 decoder
40114	16 x 4-bit static RAM [random access memory]
1115	integrated circuit for clock applications
8804	8 x 4 switching matrix
5085	integrated circuit for touch-tone dialing (transmitter)
1902A	k x 1-bit static RAM
6561	256 x 4-bit static RAM

Table 2. Key Characteristics of 4000-series CMOS Circuits



Parametr 1	Symbol	U_{DD} [V]	Min.	Max.
Klidový napájecí proud [μA] 2	I_{DDO}	5 10 15		0,5 + 50 5 + 100 50 + 300
Výstupní napětí pro L naprázdno 3 [V]	U_{OL}	5 10 15		0,1 0,1 0,1
Výstupní napětí pro H naprázdno [V] 4	U_{OH}	5 10 15	4,9 9,9 14,5	
Výstupní proud pro L [mA] 5	I_{OL}	5 10 15	0,5 0,8 3	
Výstupní proud pro H [mA] 6	I_{OH}	5 10 15	0,25 0,5 2	
Vstupní napětí pro L [V] 7	U_{SL}	5 10 15		1 2 2,5 ÷ 3
Vstupní napětí pro H [V] 8	U_{SH}	5 10 15	4 8 12	
Vstupní proud [μA] 9	I_{I}	5 10 15		1 1 5

Teplotní pracovní rozsah 0 až 70 °C, pouzdra z umělé hmoty, počet vývodů 14 nebo 16. 10
L = log. úroveň 0; H = log. úroveň 1

Key:

1. Characteristic
2. No-signal power supply current
3. Open-circuit output voltage at L [low level]
4. Open-circuit output voltage at H [high level]
5. Output current at L
6. Output current at H
7. Input voltage at L
8. Input voltage for H
9. Input current
10. Working temperature range 0-70° C; package of manmade material; 14 or 16 leads.

Most of the circuits are produced by aluminum gate CMOS technology. The silicon gate technology has also been mastered and will be used to produce the 4555 circuit, the 6561 memory and others. Ion implantation and other modern aspects of CMOS technology have been included among the manufacturing operations. Bipolar, PMOS and CMOS components combined in a single chip in such components as No 5085, a tone-dialing frequency-generator circuit for pushbutton telephones. In the Seventh 5-Year Plan, the ISO norm CMOS technology will be introduced at TESLA VUST and TESLA Piestany k. p.

Conclusions

CMOS circuitry has been used in Czechoslovakia since 1981 for the development of various types of equipment in a variety of enterprises. TESLA VUST has developed and made available hundreds of samples of circuits of various types for testing of their characteristics in specific electronic systems of future devices by more than 40 organizations.

In 1982, the total selection of 4000-series circuits was 19 types, while another 6 will be added in 1983. In addition to this series, other CMOS circuits will also be available, including memories; these are listed in Table 1. Starting in 1984, other types of circuits, such as codecs [coder-decoders] and filters, high-capacity memories and the like are expected to go into development.

The advantage of all of the circuit types that have been developed and produced will remain the fact that they have rated characteristics identical to their foreign equivalents, and their life will be guaranteed at the level $\lambda = 2 \times 10^{-5}$.

The working temperature range is from 0° to +80° C. Starting in 1984, certain types of circuits with temperature ranges of -25° to +85° C and -55° and +125° C will be gradually introduced. This selection of circuits and the guaranteed characteristics allow our enterprises to step up their innovation of digital electronic systems and to provide equipment with minimal power consumption and high electronic component reliability.

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ACHIEVEMENTS OF COMPUTER TECHNOLOGY, AUTOMATION RESEARCH INSTITUTE

Budapest SZAMITASTECHNIKA in Hungarian No 1, Jan 83 p 4

[Unsigned article: "Achievements at MTA SZTAKI"]

[Text] The citadel of domestic research and development on the automation of planning and manufacture, production and process control and robotics is the Computer Technology and Automation Research Institute (SZTAKI) of the Hungarian Academy of Sciences (MTA). The chief goal of the research and development being done in the area of applied mathematics and technical sciences is the creation of integrated systems which can be used in various areas of the economy, but especially in industry.

The institute operates the central computers and the computer network of the Academy. The work of the some 750 workers of SZTAKI is aided by a large capacity computer park (an IBM 3031, a CDC 3300, an ESZ 1035, about 20 minicomputers, PDP 11/34, TPA 11/40, ESZ 1010, TPA 7025 and a number of microcomputers). The research achievements are proven by 200-300 scientific publications per year, dozens of patents and an increasing number of production systems working in various branches of the national economy.

Within the framework of manufacturing specialization for nuclear energy equipment Hungary has undertaken the development and manufacture of a number of items of equipment for nuclear power plants. The most significant of these were research and development for and the introduction into manufacture of nuclear power plant cassette loading machines for both 440 MW and 1,000 MW blocks. The plans for the V-213 reloading machine were prepared at SZTAKI in 1981; this can be regarded as a very complex, remote control, high capacity manipulator, meeting extraordinarily high reliability requirements. It was approved by the Soviet ATOMENERGOEXPORT. The present tasks of the developmental work have a target date of the end of 1984.

Domestic and international recognition have been accorded to the development and realization of integrated machine industry data and material processing systems based on a comprehensive systems view and to increased automation of machine industry planning and of ad hoc, small and medium series manufacture. The model industrial systems realized thus far are: an integrated manufacturing system for the Machine Tool Factory of the Csepel Works, the DIAGON

500 manufacturing system for the Developmental Institute of the Machine Tool Industry Works; and the flexible manufacturing system for the United Electric and Alternator Factory. Altogether they have solved modern control for production by manufacturing equipment representing an investment value of about 500 million forints. They did the systems design for the manufacturing systems, worked out computerized control for manufacturing systems consisting of 4-5 machine tools, measuring machines, work-piece exchange and rack storage and developed the missing control units and necessary control programs.

The Budapest Technical University, the MTA SZTAKI and the Machine Industry Technology Institute established a joint experimental plant. In the experimental plant, consisting of two computerized control manufacturing cells, the necessary auxiliary units (measuring machines, tool setting and work-piece moving equipment) and a CAD (Computer Aided Design) work station, they test all the important modules and functions of later manufacturing systems.

The DIALOG CNC control equipment aroused recognition and excitement around the world; for the first time it realized a technology-oriented, dialog technique which later became a general requirement for servicing controls. The equipment works with a multidimensional interpolator, every measurement system can be used with universal track control and a single modular software package controls both milling machines and lathes. Thus far nearly 200 million forints worth of this equipment has been sold; it is manufactured by the EMG [Electronics Measuring Instruments Factory].

A programming procedure--developed jointly with the Machine Industry Technology Institute on an IBM computer--for the design of three-dimensional translation and sculptured surfaces is about to be introduced. It is a unique feature of the system that it is also suitable for the design of special sculptured surfaces.

Several Research Themes for 1982-1983:

Accentuating the contures of noisy digitalized pictures; a software system for distinguishing two-dimensional objects; recognizing three-dimensional objects with a linguistic system; robot trajectory calculation; computerized animation; a robot-vision module with a Z8000 microprocessor; obstacle avoidance algorithms; a sensor suitable for measuring three stresses or forces; robot control with a MININTEL microprocessor; turnkey CAD systems; tool design for IKARUS; parts modelling and computerized graphics; creating graphics systems for illustrations; solving control of special machine tools (for example, grinding machines and multi-angle lathes) automated manufacture of welded structures; tools for the automation of quality control and diagnostics in manufacturing systems without supervision; and the creation and operation of an experimental integrated manufacturing system.

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USE, PRODUCTION, RESEARCH ON ROBOTS

Budapest SZAMITASTECHNIKA in Hungarian No 1, Jan 83 p 4

[Article by M.M.: "Domestic Robot Use, Manufacture and R and D"]

[Text] The first phase in the development of robot technology has been completed. A wide range of industrial robots (hereinafter, robots) is offered in international trade. In addition to quantitative changes one can expect radical qualitative changes in two directions. One of these is an increase in the intelligence of robots, that is in their adaptability. The other is the mass integrated application of robots in closed technological systems, the appearance and spread of factories without people.

Technical-Economic Background

Much is said about factories without people in connection with robot technology; there are a number of such factories in operation even here. It is true that this is not in the machine industry, but rather in the chemical and foodstuffs industry, in the area of continuous technological processes. Here the material and the energy move in pipes and wires, thus the manipulation tasks are a good bit simpler, generally limited to moving valves. A few people can direct the process from a central control room, usually with the aid of a computer. Out in the plant one can see only a few maintenance and supervisory personnel. One can no longer imagine an oil refinery working with hand methods or the construction of a mill where the miller pours the wheat into the hopper. In the future plants where robots do not move the parts and tools will not be economical in the machine industry either. A country where these operations are done by human beings will be short of workers in maintenance, renovation and the preservation of fixed assets, the national wealth.

The other very essential effect of robot technology on the industry of a nation appears in the fact that in possession of the devices (e.g., motors, sensors) and methods needed to make robots and especially the more intelligent, that is the more adaptable or clever, robots the quality of other products improves also and radically new products may be born as well. The link of computer technology with the moving world expands.

Deputy minister Andras Gabor talked about these factors, among others, at the December 1981 robot applications conference; he gave a report on the robot technology plans of the Ministry of Industry. The conference was arranged by the appropriate departments of the MATE [Measurement Technology and Automation Scientific Association] and the GTE [Machine Industry Scientific Association] with the sponsorship of the Ministry of Industry and the OMFB [National Technical Development Committee] in the interest of providing an overview of the domestic situation (see the 27 December 1981 issue of MUSZAKI ELET). Dr Andras Roth reported on and evaluated the projects of the OMFB up to that time and those under way. (For details, see the PRODINFORM publication "Industrial Robots"...82/1.) The organizers collected and made available in writing the chief technical data on domestic robot applications up to that time and showed in a film the circumstances of some of the applications. They collected data in questionnaires from the more than 100 participants concerning applications to be expected.

Our Domestic Achievements

The picture obtained is very promising. It appears that after a long passive period, even compared to our CEMA partners, events are accelerating. Within the framework of a target program the industry leadership is devoting a relatively large sum to domestic robot technology developments. The theme found a patron at United Incadescent, where they have already achieved a significant export success with their simple pneumatic robots designed to move color picture tubes and where they have undertaken the development, manufacture and domestic propagation of more complex, electric servo driven robots. Relying on the GTI [Machine Industry Technological Institute] they planned a basic survey of domestic user needs and planned to propose a competition for financial support for the use of domestic robots and those manufactured by our CEMA partners, primarily in Bulgaria and Czechoslovakia. The robot manufacturing plans of United Incandescent promised a sound applications background for domestic robot technology research, among others that taking place at MTA SZTAKI [Computer Technology and Automation Research Institute of the Hungarian Academy of Sciences]. A Robot Professional Council was formed with the participation of those interested in the project under the leadership of Istvan Muller, a deputy chairman of the OMFB.

Unfortunately a number of factors are holding back the original impetus. Crucial among these are the investment and foreign exchange restrictions accompanying our economic difficulties. Nor is the acquisition of robots from socialist countries without difficulties. (Only in the recent past did the Machine Tool Factory of the Csepel Works get its first Bulgarian robot.) The reorganizations connected with the electronics program also caused delays.

As can be seen from the foregoing also, the following centers dealing with robotics developed in the country.

The MTA SZTAKI took part earlier in the development of pneumatic robots. At present it is concentrating its activities on increasing the adaptability of robots, the development of seeing and feeling sensors and guidance algorithms and questions of their use (primarily in assembly). They have created conditions for laboratory and on-the-spot testing of robots and thus support domestic robot users in their possible disputes with shippers.

Questions of robot applications are being studied at the machine manufacture technology faculty of the Budapest Technical University--partly in conjunction with the SZTAKI.

A number of our enterprises also are dealing with robot development, primarily United Incandescent. On the basis of a Soviet license the GTI has adapted the PRC 1 robot to service pressing machines and this is being manufactured by United Incandescent. The VSZMGY [expansion unknown] has developed a pneumatic robot to service plastic injection machines and, for the time being, is manufacturing them only for its own use. The MOFEM [expansion unknown] is manufacturing pneumatic robots to service metal injection molding machines, on the basis of a license from the Swedish firm Tour and Anderson. Within the framework of a license acquired for an assembly system the Bakony Works is manufacturing simple pneumatic loading robots. The Egri Precision Fittings Factory supplies the pneumatic parts for all these pneumatic robots.

A number of our large enterprises have worked out plans for the use of robots within the framework of which they have installed robots and are in the process of acquiring others. These include, among others: IKARUS, with robots for painting, welding and assembly and to service pressing machines; the Csepel Works, with robots for welding, to service machine tools, clean castings and perform other heavy metallurgical operations; the MEZOGEP Trust, with robots for welding and to service pressing machines and machine tools; the FIM [expansion unknown], with painting robots; and Ganz-MAVAG, with robots to service die cutting machines.

It can be established from the uses thus far that for the most part they involve the isolated use of individual robots--usually only as an experiment. The two institutions mentioned last are an exception to this; they have three and two robots respectively installed on the production line working constantly together. It is also characteristic that a different type of robot can be found virtually everywhere and that types of domestic manufacture are not in great demand.

...And Our Possibilities

In neighboring CEMA partner countries they are researching the possibilities of robotization of their domestic industries within the framework of stressed central programs. It is well known that special CEMA agreements deal with the joint development of robot technology.

Within the framework of this work standardization agreements are being born; relying on these the individual countries can undertake, within the framework of bilateral agreements, the robotization of this or that technology, usually in such a way that one party manufactures the technological equipment and the other manufactures the robots. A number of such cooperations are under way; unfortunately we are not yet involved in one of them.

We hope that the robot applications competition soon to be published--perhaps it will have been published by the time this article appears--will give a new impetus to domestic robot technology developments and that this technology, of vital importance from the viewpoint of the future competitiveness of our machine industry, will win its worthy place in our economic life. This is a condition if we are to find our machine industry enterprises in the ranks of factories without people.

8984
CSO: 2502/29

HUNGARY

ROBOTS, AUTOMATION IN GDR

Budapest SZAMITASTECHNIKA in Hungarian No 1, Jan 83 p 6

[Article by R. Georgi: "GDR: Robot Technology--Modern Manufacturing Automation"]

[Text] The chief task, in harmony with increasing the intensity of reproduction processes, is further automation of production processes. The introduction of modern robot technology, realized with the aid of microelectronics and computer technology, is of great significance.

The technological level increases with the use of industrial robots. The introduction of robot technology is the chief direction of rationalization. In the course of preparing the 5-year plan for 1981-1985 the GDR announced at the 10th party congress and in a resolution, an intensive increase in the level of production and the placing into operation of about 40,000-45,000 industrial robots. In addition to centralized manufacture of industrial robots they will develop and manufacture process-specific industrial robots also. The robots will go primarily to those places where they can take over work difficult for humans. This is especially significant in servicing machine tools where increasing the performance of machines and tools and decreasing the base time and the manufacturing time per unit would cause greater physical and psychological burdens for those working at the machine tools.

By 1985 about 100,000 will be working under new work conditions in the GDR. This trend characterizes machine tool manufacture in the GDR. For example, the VEB machine tool factory in Berlin has developed, jointly with the machine tool factory's research institute in Karl Marx Stadt, a series of feeder robots. Beginning in 1982 an ever increasing number of the products of the Fritz Heckert machine tool factory combine in Karl Marx Stadt have been made with the use of industrial robot technology. But this also applies to other plants and combines manufacturing machine tools and working machines in the GDR. Robots have been developed to rationalize dressmaking tasks for equipment producing textile products and to remove parts in equipment processing synthetics.

In the manufacture of machine tools and processing machines industrial robots are used on set-up and casting jobs and to rationalize welding tasks. The development of technological robots* represents the base in the area of machine manufacture, manufacture of agricultural machines, vehicle manufacture, metallurgy and electronics. Industrial robots with varying levels of automation are being introduced in accordance with the different products and manufactures of machine tools and processing machines. Simple control devices are used for machine tools mass produced in large series but for CNC controlled machine tools they use highly flexible robots with several NC controlled axes.

Preparations are being made to use the sensors used in industrial robots. They have worked out already in the GDR the first solutions in use of picture recognition for precision engineering assembly processes. The microelectronic controls needed for manufacture of machine tools and processing machines are available in various degrees of completion for industrial robots in order to carry out other control tasks.

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* Robots are divided into two types according to the character of their activity: a. material handling robots only "move" the parts, usually loading them and/or putting them into or taking them from the working machines; b. the working or technological robots take part in the working of the material or parts. The most extensive operations are: welding, surface coating, polishing, drilling and assembly. (The Editors)

8984
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ACHIEVEMENTS OF BULGARIAN ELECTRONICS

Budapest SZAMITASTECHNIKA in Hungarian No 1, Jan 83 p 9

[Article by Dr Tamas Boromisza: "Once Again From Plovdiv; The Achievements of the Bulgarian Electronics Industry"]

[Text] The first Plovdiv fair opened 90 years ago, on August 1892, with 24 countries participating. In 1982 about 50 countries were represented at the fall Plovdiv fair, on 170,000 square meters and in 29 permanent exhibit pavilions. With regard to the character of the fair the majority of the participating countries exhibited machine manufacture, heavy machinery and agricultural machines. Of the CEMA countries the exhibit of Bulgaria was the most extensive. This article is not a fair report; its purpose is to give a comprehensive picture of the achievements of Bulgarian industry by reporting on the achievemenets of the Bulgarian electronics and computer technology industry. We will report on several outstanding products and achievements, primarily in the interest of laying the foundation for some summary observations.

Industry Development

One of the national economic goals of Bulgaria is for the size of the national income in 1985 to exceed that of 1980 by 20 percent. In the 1981-1985 5-year plan special treatment is given to the status of scientific-technical research and development, including questions of modern industrialization and industry development. According to the plans the volume of industrial production in 1985 will be about 130 percent that of 1980; that is, it will increase by 30 percent. They see in the further development of a modern electronics and computer technology industry one of the fundamental factors for increasing industrial production.

What is the situation in this area now? According to official sources the ISOTIMPEX Foreign Trade Enterprise has export contacts with more than 60 countries. The annual rate of development of Bulgarian electronics industry production is around 20 percent. When putting out products special attention is given to systems embracing modern design, manufacture and control as a whole.

At the press conference of experts from ISOTIMPEX they made special mention of the ESZ 1035 computer and the associated ESZ 2335 matrix processor, which makes possible data processing at speeds a good bit greater than before. Similarly great interest was shown in the SZM-4 computer, which operates with the ESZ 1035 through a channel/channel adaptor. In addition to expressly computer technology applications an ever greater role is being given to various goal-oriented data processing, process control, production control and special measurement data collection systems. In the future also they want to give special treatment to research and development work in electronics and computer technology. They will expand the assortment of magnetic disk stores with 317, 500 and 1,000 M bit units and with 20-80 M bit minidisk units. In the case of magnetic tape storage they will increase the speed of data exchange per minute to 320 and 786 K bits.

A Decentralized Guidance-Control System for Water Affairs

This contains a central unit and several technological process control units. Measurement data collection and guidance are the tasks of the basic units. The input and output characteristics are: control of 512 executive organs, querying 256 analog channels, issuing 160 control signals, receiving 96 dynamic digital signals and receiving 96 frequency signals. Connections can be by standard telephone, radio channel or special cable. The central unit is a microcomputer with a storage capacity of 128 K bytes, to which one can connect a video terminal and a printer.

An Environment Protection Control System

This is a measurement system which can be used in industrial and urban environments; it continually checks various meteorological parameters and air and water quality parameters. A maximum of 60 substations can be connected to the central control unit. The microprocessor substations can receive signals from a maximum of 64 remote transmitters.

The substations work without supervision and are connected by standard telecommunications channels to the central control unit, which can be built up in several versions--a 16 K bit microcomputer, a 32 K bit ISOT 0310 microcomputer and an SZM-4 minicomputer. The microprocessor substations work with an RTOS real-time operating system developed for the SZM 600 microprocessors of Bulgarian manufacture. This also applies to the microcomputers with a capacity of 16 K bits.

The ISOT 1003 C Hotel Data Processing System

Its operational store goes up to 24-32 K bits. The system includes three 250 K bit floppy disks and a 30 character per second ISOT printer. The system prepares statistics on hotel occupancy, room records and accounting.

ASU Labor Microprocessor Laboratory Test System

This operates with an 8 bit ISOT 220 microcomputer. An SZM 1604 video terminal, SZM 6312 daisy wheel printer, floppy disk, punch tape reader and data transmission unit can be connected to the system. The programs are written in RT-BASIC.

A mock-up demonstrated glass industry or construction industry application of the Programa 1024 PLC. The P 1024 PLC placed at the lower level can handle a maximum of 1,024 discrete inputs and outputs and 32 analog inputs and outputs. A maximum of 64 PLC's can be connected to the SZM-4 minicomputer at the upper level, at a data transmission distance of 1.5 kilometers. This system is a further development of the earlier PLC with 700 inputs and outputs, which is used in brick factories. This system could be seen only in mock-up as they had installed only several modules of the PLC unit.

A System to Regulate Hothouse Microclimate

This regulates interior temperature and humidity in accordance with the meteorological conditions of the environment and the microclimate inside the hothouse. The number of control outputs is a maximum of 56. The system is used in a number of large Bulgarian installations and in developing countries.

IDAS PROCON-T Production Control System

This was designed primarily for use in textile mills. The SZM 9106 central unit can be expanded by eights, attaching FT-micro intelligent machine handling consoles. These have a 16 character alphanumeric display, a keyboard and 16 bit digital inputs and outputs.

ISOT 9200 Multichannel Digital Control Unit

These carry out industrial control tasks independently or connected into a hierarchic system. The regulator is built up of LSI circuits in the SZM 600 series and TTL elements. Sixteen ISOT 9200 C regulators can be connected to an ISOT 7400 C operator's console. The maximum data transmission distance is 3,000 meters.

At the highest level there is an SZM-4 minicomputer. According to information provided by the experts the system is analogous to the Honeywell TDC 2000 system.

ISOT 6902 C Stenographic System

This is a text recorder based on the SZM 600 microprocessor family. An IBM typewriter and 82 C and 196 C printers can be connected to the system via a diabolo and RS 2 C interface. The character set can be varied as needed (Cyrillic, Latin and Japanese).

Automatic Guidance and Control System for Decentralized Hydrotechnical Installations

Various water installations (watersheds, channels, dams, reservoirs, syphons) make up a technological system scattered over a wide area. A microprocessor terminal provides lower level control while at the comprehensive upper level they use a microcomputer with a capacity of 128 K bit words, supplemented with a video terminal.

ISOT 1025 Sberkassa Bookkeeping Terminal

This is based on the SZM 600 microprocessor family. It is outstanding for its exterior design, the design having been done by the FRG Iterform firm. This is a further development of an earlier design (the ISOT 1005 C).

ISOT 1008 C Gasoline Designation System

This takes care of automatic fuel dispensing and administration in state auto maintenance installations. The system can handle eight or sixteen filling stations. Identity data and customer needs are transmitted via ISOT 1018 C magnetic card input equipment connected to the system. Both systems are based on the SZM 600 microprocessor.

ISOT 0470 Microcomputer Family

This includes two microcomputers--a microcomputer with 16,132 bytes of operational storage and a terminal with 4 K bits of storage. The ISOT 0470 computer is used in industrial gas chromatography, in potentiometric spheres and in other industrial measurement and control equipment.

ISOT 7400 C Machine Handling Console With Terminal and Printer

Data input in the equipment, connected to an SZM-4 central computer, takes place with the aid of the cascade communication channel of the mono- or multichannel digital control unit of the computer.

DISPRO Problem-Oriented System

This is an operational dispatcher system with high level services, for production control purposes, based on an ISOT 1016 C (SZM-4) ROBOTRON 1600 data collector, RVT 4000 and SZM 1604 programmable terminals and RUVO (SZM 9106) distributed communication devices.

The ZPP-RUSZE factory manufactures elements of an automatic testing and electric control (ATEK) system--the ISOT 1009 C automatically assembled unit testing system; the ISOT 1010 C, the ISOT 1009 model supplemented for dynamic tests in real-time systems; the ISOT 1011 C, to test analog printed circuit cards; and the ISOT 1012 C, an automatic system to produce testing programs.

In the electronic cash register category the Bulgarians exhibited the newest ELKA 90 cash-register terminal, which has an automatic magnetic stripe code reader; if desired a Hewlett Packard line code reader can be attached in the place of the magnetic stripe code reader. The ELKA 98 was developed for restaurant use; it provides personal key accounting for 20 waiters and three chiefs.

Lessons

The development of the Bulgarian electronics industry, including the broad economic application of microprocessors, is vigorous. The majority of the LSI elements built into their equipment is of Bulgarian manufacture (SZM 600 type microprocessors); to an overwhelming extent they are working with a parts base which does not come from the capitalist relationship. The lack of cheap matrix printers compatible with the microcomputers in price and performance is strongly felt. In most applications they are using daisy wheel printers of ISOT manufacture.

The Bulgarian industry is expecting very much from joint manufacturing and trade association with various capitalist firms. The effect of this is being felt already in the design and purposes of the equipment.

8984
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POLAND

MILITARY DEVELOPMENT OF LASER SYSTEMS DESCRIBED

Continuous-Wave Laser

Warsaw POLISH TECHNICAL REVIEW in English No 5-6, May-Jun 82 pp 4-5

[Article by Zdzislaw Jankiewicz, Marek Mindak, Wieslaw Pichola and Jerzy Szydlak, Warsaw]

[Text] The LCB-6B continuous-wave laser developed and built at the Institute of Optoelectronics of the Military Technical Academy, Warsaw, generates a beam of monochromatic infrared radiation ($\lambda = 1.06\ \mu m$) with power of 50 W, and finds application for cutting semi-conductor structures, in scientific research and for didactic purposes. It comprises: a laser head assembly, a power supply circuit and a cooling system.

The laser head assembly

The active material of this laser is constituted by an yttrium-aluminium garnet crystal containing an admixture of neodymium (YAG: Nd^{3+}) and measuring Φ 5 mm × 80 mm. Its faces are coated with anti-reflection layers. The laser rod made of the active material and a linear krypton tube exciting it are both placed in the two foci of an elliptical reflector. The reflecting surfaces of the reflector (side and face surfaces) are gold-coated.

Reflector length is equal to that of the arc of the krypton tube (75 mm). The krypton tube and the rod are placed in glass tubes. The krypton tube, the active material and the reflector are cooled by independent water circulation systems. The latter elements (tube and active material) constitute, together with the tube current terminals and water supply connections, the readily dismantable laser head which ensures optimum operating conditions for the laser rod and the exciting tube, while allowing their simple and easy replacement. The laser head and the mirror holders are fastened to a stable base.

Such a solution ensures high rigidity of the whole structure, and ensures stable laser operation in the presence of vibrations common in various industrial applications. It is also possible to dismantle quickly the laser head without altering the alignment of the resonator. The resonator is 270 mm long and is constituted by two mirrors: a totally reflecting concave mirror with a radius of curvature equal to 5 m, and a partly transmitting plane mirror with a reflectivity of $R_2 = 90\%$. The mirrors are fastened in holders.

The laser can be used for multimode operation or in the TEM_{00} fundamental mode. In the latter case it is necessary to equip the resonator with a diaphragm with a diameter of 1.7 mm. External dimensions of the laser (protective shield) are 360 × 125 × 120 mm. The laser is connected with a supply circuit by means of power cables, and with the cooling system by means of water hoses.

The energy characteristics of a laser in multi-mode operation and of that operating in the fundamental mode are shown in Fig. 3.

In case of multi-mode generation, the maximum power of the laser exceeds 50 W. Beam divergence is high in that case and increases linearly with power (Fig. 3b). In single-mode operation, the beam power is much smaller but the divergence decreases considerably (it is constant and equal to 1.1 ± 0.2 mrad).

The power supply

The principle of power supply operation is illustrated in its block diagram (Fig. 4). Basic functional blocks of the power supply are: a main power supply, a pulser, a starting power supply and a three-phase transformer. The main power supply incorporates final control units for output voltage control and an *LC* filter. Smooth output power control is effected by controlling the opening angle of three thyristors connected to the individual phases of the mains. The two section *LC* filter decreases the output voltage pulsations to the level of 1 V.

Tube ignition is ensured by the pulser and the starting power supply. The pulser has at its output a pulse transformer and generates a high voltage pulse (25 kV) which initiates the gas discharge lamp (tube) ignition, the starting power supply preserving and increasing the ionized gas channel. When the starting power supply output voltage level drops below the main power supply output voltage level, the diode is opened, and the discharge tube is connected to the main power supply source. The power supply cannot be switched on, or its operation is interrupted by a special system of interlocks and protections. This occurs

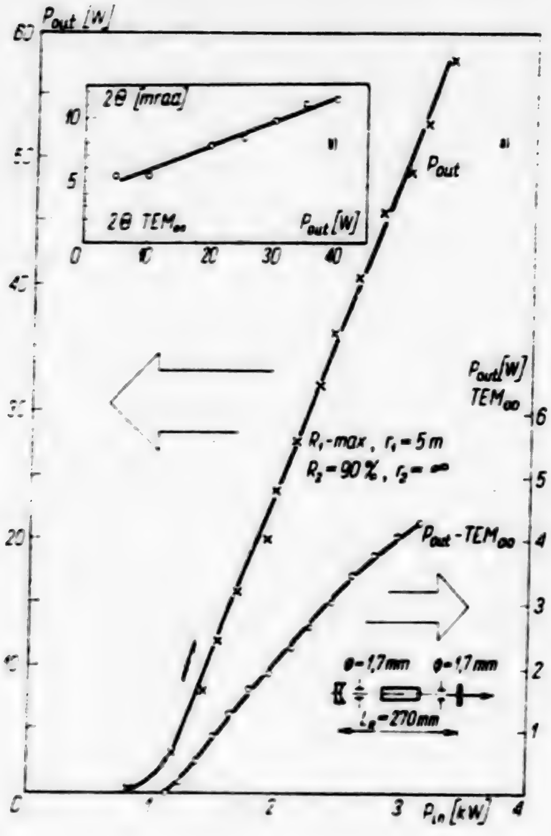


Fig. 3a. Dependence of output power on pumping power for single- and multi-mode operation: P_{out} — generated power (output), P_{in} — pumping power, R_1 — reflectivity of the totally reflecting mirror, r_1 — radius of curvature of the totally reflecting mirror, R_2 — reflectivity of the transmission mirror, r_2 — radius of curvature of the transmission mirror

Fig. 3b. Dependence of output beam divergence on its power (for multimode operation): 2θ — beam divergence

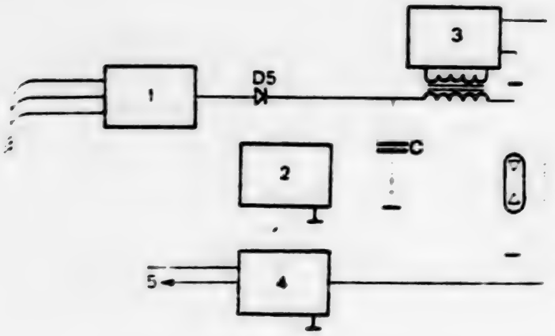


Fig. 4. Block diagram of the LCD-6B continuous-wave laser power supply. 1 – main power supply, 2 – starting power supply, 3 – pulser, 4 – control block, 5 – to the cooling system

when: one of the mains voltage phases is missing; the laser head cooling liquid pressure drops below the required level; the temperature of the laser head cooling liquid is above the preset level; the power supply output current exceeds its maximum preset value. The interlocks and protections system also controls the operation of an electromagnetic valve in the process water cycle, which maintains the closed-cycle circulating liquid temperature at a desired level.

Maximum output power is 5 kW, maximum main power supply current is 40 A, output voltage pulsations are 1 V, long-term output power instability ± 1%/2 hrs, pulser output voltage — not less than 25 kV, starting power supply output voltage is 2 kV, power mains 3 × 220 V, 50 Hz, 32 A. The power supply is placed in two housings measuring 438 × 350 × 450 mm and 438 × 478 × 450 mm.

The cooling system

The cooling system is designed to provide an adequate laser head temperature stabilization during continuous operation of the laser within the complete power supply range at ambient temperatures of up to 35°C. In these conditions the temperature of the laser cooling liquid is maitained in the range of 28° to 32°C.

The cooling liquid is moreover being continuously filtered and deionized, and should not change its properties during at least 200 hours of laser operation.

The cooling system is provided with two independent water circulation systems: a closed cycle with a flowrate of 14 l/min forced by a centrifugal pump, and an external process water circulation system. The heat removed from the laser head is transferred to the external cycle in a heat exchanger. Temperature of the water in the closed cycle is stabilized at a preset level with an accuracy of up to ± 2°C.

For prolonged laser operation (for tubes type 4 Kr 3 with a maximum power rating of 3.5 kW) it is necessary to ensure a process water flow rate of 25 l/min, water temperature not exceeding 15°C. The pumping tube is switched off when process water pressure drops down to zero. Cooling system housing dimensions: 348 × 350 × × 450 mm.

YAG 50B Pulsed Laser

Warsaw POLISH TECHNICAL REVIEW in English No 5-6, May-Jun 82 pp 6-7

[Article by Zdzislaw Jankiewicz, Wieslaw Pichola, Marek Skorczakowski and Jerzy Szydlak, Warsaw]

[Text]

The laser YAG 50B developed and built at the Institute of Optoelectronics of the Military Technical

Academy, Warsaw, is designed for working abrasion-resisting materials (boring of holes), for scientific research applications and use in medicine (interventions inside the eyeball), and for teaching purposes. It consists of three basic functional assemblies: the supply system, the cooling system, and the laser head assembly.

The supply circuit

The supply circuit is designed chiefly for supplying energy to the active material pumping lamp. Its ancilliary functions are: the time synchronization of the generation process, the Q-modulator supply, the protection of system assemblies against incorrect operating conditions, the counting of pulses. The supply circuit interlocks make possible its emergency switching off or prevent its switching on when the pressure of the fluid cooling the laser head is lower than required, the temperature of the coolant exceeds the preset value (35°C), the discharge tube voltage exceeds the preset value, or when the lasser head cover is opened.

The actual cause of emergency is signalled by control lamps on the power supply face plate.

Technical data of the power supply circuit

Maximum average output power	600 W (continuous operation) 1200 W (2 min. operation) followed by a 2 min. break/
Charging voltage control range	500...1500 V
Main capacitor bank capacity	60 μF
Charging voltage stability	1%
Charging rate	500...1200 J/s
Pulser voltage	not less than 20 kV
Pumping rate (stepwise controlled),	2, 5, 10, 20, 30, 50 Hz
Ignition pulse duration	2 μs
Supply	220 V, 50 Hz, 10 A

The pulser may be triggered off from an external generator or using a manual-operated switch. The shot counter may also operate as a reversion counter making possible the programming of the number of shots in the range 1...9998. A complete supply set is constituted by two separable, standard housings measuring 438 × 350 × 170 mm.

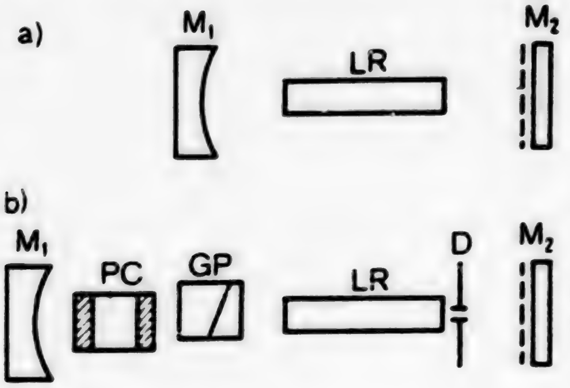


Fig. 2. Configuration of the YAG 50B pulsed laser: *a* – free generation, *b* – giant pulse generation, M_1 concave mirror $T = 0$, *LR* – laser rod, M_2 – mirror $T = 0.15$, *PC* – Pockels' cell, *GP* – Glan polarizer, *D* – diaphragm

Basic specifications of the YAG 50B laser

Specification	Free generation (multimode operation)	Q – modulation	
		Multimode operation	Single-mode operation
Energy generated (mJ) at $E_{pump} = 30J$	180	70	10
Threshold pumping energy, J	5.8	7	7
Pulse duration, ns (at $E_{pump} = 20J$)	220 × 10³	6	4
Beam divergence 2 Θ	3	3	1.2
Efficiency of conversion to second harmonics, %	–	14	30

The cooling system

The cooling system is provided with two independent water circulation systems, i.e. the distilled water cycle cooling the elements of the laser head, and the process water cycle taking the excess heat away from the distilled water. The cooling system comprises: a distilled water tank holding 9.5 l, a centrifugal pump with an output of 5.5 l/min, a heat exchanger (a cooler), a distilled water filter and a deionizer. All components of the cooling system are accommodated in a standard housing measuring 438 × 350 × 170 mm. The distilled water flow rate and heat exchanger efficiency are sufficient to effectively remove the excess heat from the laser head supplied with total average power from the supply circuit, process water flow rate being equal to 25 l/min and its temperature not higher than 15°C.

The laser head assembly

The laser pulse is generated by this assembly and the time and spatial parameters of the pulse are formed there as well.

The laser head assembly comprises: the laser head proper and a resonator in the case of free generation (Fig. 2a) and an optional resonator Q — switch in the version developed for generating giant pulses. This assembly may be additionally fitted with a diaphragm giving forced operation of the laser in the basic TEMoo mode, and a radiation converter to the second harmonics. The laser head incorporates a YAG: Nd^{3+} rod ϕ 3 mm × 55 mm, a gas discharge lamp 3F 2 K, an elliptical reflector and two front reflectors, voltage application terminals and coolant inlet lines. The rod and the lamp are placed in the foci of the elliptical reflector. The inside surfaces of the reflectors are gold coated. The voltage input terminals are made of flexible elements, which considerably increases the effective service life of the discharge lamp. The laser head design guarantees that it is placed in a fixed position with respect to the resonator axis. Consequently, the disassembly and assembly of the head does not change the laser alignment. The resonator consists of two total reflection mirrors (spherical mirrors) with a radius of curvature equal to 5 m, and a semi-transmitting plane mirror (transmission T = 0.15). The resonator mirrors are mounted in holders. The total reflection mirror holder may be held in two positions, depending on the kind of laser operation. As a result, during free generation the resonator base length is minimal and equal to that of the lamp (~ 200 mm), Fig. 2a.

In the Q-modulation operation the resonator length is extended by that of the Pockels' electro-optical switch, and its total length is then 280 mm (Fig. 2b). The Q-modulator comprises a Pockels' cell utilizing the longitudinal electro-optical effect, a polarizer and an electronic supply circuit. All modulator components are mounted on a tilting table making possible a colinear positioning of the KDDP crystal optical axis with respect to that of the resonator. The frequency doubler converting radiation with a wave length $\lambda = 1.06$ µm to that of $\lambda = 0.53$ µm is made of a KDP crystal cut specially for oo-e type interaction, and is also mounted on the tilting table.

All the above specified components of the laser head assembly are fastened to a common, rigid base ensuring excellent stability of the resonator base, which is insensitive to shocks and temperature variations. The laser head assembly is covered by a protective shield. The distance of the resonator optical axis from the bottom surface of the base is equal to 56 mm.

The laser head assembly without the protective shield is shown.

Low-Power He-Ne Laser Head

Warsaw POLISH TECHNICAL REVIEW in English No 5-6, May-Jun 82 p 8

[Article by Maksym Gebczak and Jerzy Tuszynski, Warsaw]

[Text] A series of LM-type He-Ne laser heads designed for use in laser geodetic instruments has been developed at the Institute of Optoelectronics of the Military Technical Academy, Warsaw. These heads may find application in all fields of laser-based metrology. The LM-type He-Ne laser heads feature good mechanical, thermal and power stability characteristics. The concentric discharge tube is closed by Brewster's plates, which ensures linear polarization of the laser beam. An aluminium cold cathode has been applied.

The discharge tube is placed in an aluminium alloy cylindrical housing and filled with a flexible filling compound that is a good heat conductor. This design ensures good resistance of the laser head to changing ambient conditions. The laser mirrors fastened in special holders make possible convenient alignment of the laser head, and make it both dust-proof and steam tight.

The laser heads incorporate a "hemispherical" resonator, ensuring the TMoog mode operation.

Technical data of three types of He-Ne laser heads

	LM-200	LM-300	LM-500
Output power, mN	0.5	2	5
Wavelength, nm	632.8	632.8	632.8
Spot diameter, mm	0.75	1.2	1.2
Divergence, mrad	1.5	1	1
Axial mode spaning, MHz	810	516	353
Power stability, %	± 5	± 5	± 5
Operating temperature range, °C	–20...+50	–20...+50	–20...+50
Operating current, mA	5 ± 0.5	6 ± 0.5	6 ± 0.5
Operating voltage, V	1100±100	1500±150	2400±200
Ignition voltage, kV	6	9	9
Dimensions (length × diameter), mm	195×39	300×39	435×39

CSO: 2020/21

POLAND

MAJOR DEVELOPMENTS IN ELECTRONICS DESCRIBED

HS-1 Holocamera

Warsaw POLISH TECHNICAL REVIEW in English No 56-, May-Jun 82 pp 10-12

[Article by Zdzislaw Jankiewicz, Wlodzimierz Nowakowski and Wieslaw Bobak, Warsaw]

[Text] The HS-1 holographic camera developed at the Institute of Optoelectronics of the Military Technical Academy is designed for investigating the deformation of objects using double-pulse holographic interferometry methods. This unique measuring system has been built for fundamental research laboratories, but its mobile structure makes it also suitable for performing measurements in industrial conditions.

This equipment comprises two basic assemblies:

— the optical-mechanical assembly mounted on a platform resting on a TV tripod,

— the electronic assembly incorporating supply and control circuits.

The HS-1 holographic camera is shown.

The optical-mechanical assembly

This assembly comprises laser systems and the beam forming optical and mechanical elements. Their arrangement is shown in Fig. 2.

The obtaining of suitable spectral, spatial and time characteristics of laser radiation is the major problem in the holographic recording of objects with the use of a pulse-type light source. The laser generator should be capable of generating a pair of giant pulses of sufficiently close energies and adequate coherence. The time interval should be controlled over a wide range of values. The method of gradual cutting off the resonator losses has been applied for obtaining the formed pair of pulses [1].

The generator *1* has been fitted with a double-tube head equipped with a ruby rod 110 mm long and with a diameter of 9 mm. Rod faces are perpendicular to its axis and coated with antireflexion layers. The 500 mm long resonator is constituted by two mirrors: the dielectric mirror *M* with an energy reflexion coefficient R = 0.99 and radius of curvature r = 2,000 mm and the selector (reflector) of longitudinal modes *Ms*. The mode selector is placed in a thermostat whose temperature is controlled to an accuracy of ±0.03°C. The electronic temperature control and stabilization system makes possible the selection of a correct operating temperature point of the resonance reflector, so that the maximum of its spectral characteristic is superimposed on the maximum of the fluorescence line of the active material. At the same time, stable operation is ensured at any point of the characteristic. The resona-

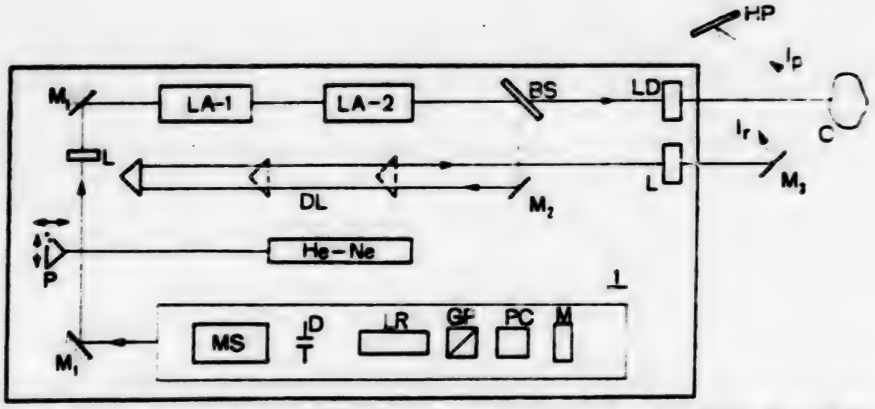


Fig. 2. Optical diagram of the holocamera: *1* – laser generator, *LR* – laser head, *M* – dielectric mirror, *R* = 0.99, *PC* – Pockels' call, *GP* – polarizer, *D* – diaphragm, *MS* – longitudinal modes selector, $M_{1,2,3}$ – directing mirrors, *He-Ne* – adjustment laser *P* — directing prism, L_1 – divergent lens, *LA-1* – first amplifier, *LA-2* second amplifier, *BS* – power divider, *DL* – optical delay line, *L* – divergent lens, *O* – object being investigated, *HP* – holographic plate, *LD* – expanding scattering system, J_p – object beam, J_r – reference beam

tor also comprises the diaphragm *D* forcing operation in the basic (fundamental) mode *TEMoo*. As a result, a single mode is obtained at the laser generator output, which in turn ensures a sufficiently large radiation coherence path so that adequate depth of the scene being holographed is attained. In the case of the HS-1 holocamera, the depth is equal to 2 m.

The platform on which the generator is mounted is also thermostatted with an accuracy of ±0.5°C in order to maintain a suitable stability level of the power and spectral parameters of the radiation generated.

The half- power duration of the laser pulses are τ = 30 ns, the spacing between them being controlled in the range of 2 μs to 500 μs. This way of pulse generation is based on the theory of generating pulse trains by the method of gradual cutting off the resonator losses, described in the work [1].

High operating stability of a laser generator, and especially of a single mode, is known to be possible in the case of small generation threshold value overshoots. Consequently, pulse energies obtained cannot be large, a typical laser generator output pulse energy being equal in such a case to 10 mJ only. On the other hand, it is required that the holographed scene should have an area of at least 1 m². It is therefore necessary to use laser amplifiers. The device described incorporates two pulse amplification stages. The first *LA-1* is based on a rod 110 mm long, dia. 8 mm, excited by means of six xenon tubes VQX1310. The other one, *LA-2* is fitted with a ruby rod 110 mm long, dia. 12 mm and also excited by six xenon tubes of the same type. The generating and amplifying heads are of a relatively simple design. They comprise cylindrical diffusion reflectors (magnesium oxide), and the tubes can be readily replaced without disassembling the heads. Both the rod and the tubes are cooled with distilled water in a closed cycle, water temperature being stabilized. Generator output beam diameter is 1.8 mm (fundamental mode diameter). The parameters of the lens L_1 placed in the laser beam path have been selected in such a way as to utilize as much as possible the active aperture of the amplifier rods. The amplifier output pulse energy is 0.5 J, power distribution in the crossection being approximately Gaussian.

It is well known that two beams are necessary in order to obtain a holographic picture: the object beam illuminating the object to be holographeed, and the reference beam. In the HS-1 holocamera, the reference beam is obtained by dividing up the radiation of the second amplification stage, a fixed unergy beam-splitter *BS* with a power ratio of 1:50 being used. The reference beam J_r is directed onto the optical line DL with stepwise control of optical path (3 positions).

This arrangement makes it possible to equalize the optical paths for the inetrfering beams in the plane of the light-sensitive material for elements of the object situated at a distace of 1 ± 0.5 m from the holocamera. After leaving the delay line, the reference beam is directed via the mirror M_3 onto the holographic plate. The radiation remaining after the division constitutes the object beam J_p. In order to attain a uniform illumination of the object being holographed, the object beam is appropriately formed in a special expanding and scattering system LD. The LD system compises a single expanding lens and a diffuser with double-sided scattering surfaces of different gradation. After being reflected from the object to be holographed, the thus formed radiation interferes with the reference beam and, hence, makes it possible to record a hologram. The holographic plate is mounted in a holder fastened to the external housing of the holocamera. After double exposure (illumination of the object by two pulses) the obtained interferogram provides information about any change of the state of the objects in the period between the successive laser pulses. The distribution and nature of the fringes may be used to determine the dynamics of object changes, areas under particular stress, and / or to localize discontinuities in material structure, and to find local defects of equipment being tested.

Typical pictures derived from holograms are shown.

The electronic assembly

The supply and control of the pulsed laser and other circuits incorporated in the optical-mechanical assembly are effected by the electronic assembly which features a modular design and comprises:

— a charging module,
— forming modules,
— a stabilization and modulation module,
— laser heads temperature stabilization module,
— capacitor bank auxiliary modules,
— a voltage divider module.

The adjustment of these systems is done by a synchronizing module which performs the following functions:

— passes the instruction for charging the capacitor bank,
— signals the end of the charging process after a preset voltage has been attained,
— releases the ignition of the exciting tubes,
— gives the modulator a triggering pulse,
— effects the emergency discharging of the capacitor bank.

Depending on requirements, the generator may be switched on without the amplifiers, or with only one of them, by switching off the corresponding forming modules. The stabilization modules make possible the maintenance of the preset temperature values of the longitudinal modes selector, and of the platform and the media cooling the active material and the tubes in the laser heads. The laser heads temperature stabilization module is a versatile piece of equipment which may be used in various types of solid lasers. The cooling medium flow is forced by a small-sized, highly efficient pump. The cooling water is deionized and filtered.

This module operates in the temperature range of 10° to 35°C and keeps the present temperature constant to ±0.5°C thanks to the application of a special cooling and heating system. The stabilization and modulation module circuits are switched on individually. The generator controlling the operation of the electro-optical modulator is incorporated in the latter module, and generates pulses of smoothly tunable voltage in the range 100... ...3000 V, the pulse time lag being controllable in the range of 2 to 500 μs. The electronic assemblies are mounted on a special trolley. Their modular design makes it possible to set on various power supply configurations which may be used for setting up laser systems for various applications.

Technical data of the HS-1 holocamera

Single pulse duration	30 ns
Time separation of two pulses	2–500 µs ± 1 µs
Energy of a single laser pulse after amplification in the *TEMoo* mode	0.5 J
Coherence path length	2 m
Optical path equalization compensation	1.5 m
Repetition rate	1/60 Hz
Wavelength λ	694.3 nm
Electrooptical modulator: a KD*P Pockels' cell	$U_{\lambda/4} = 2.2$ kV
Weight of the optical-mechanical assembly	80 kgs
Dimensions of the optical-mechanical assembly	1.1 × 0.45 × 0.4 m
Elctronic assembly supply	220 V, 50 Hz
Capacitor bank capacity	7 × 210 µF
Laser supply voltage	1...3.5 kV

References

[1] Z. Jankiewicz: "Generation of laser pulse trains by the method of gradual cutting off the resonator losses". Supplement to the Military Academy Bulletin No. 8, (336), 1980

Microprocessor Bipolar Integrated Circuits

Warsaw POLISH TECHNICAL REVIEW in English No 5-6, May-Jun 82 pp 15-16

[Article by Jacek Baykowski, Danuta Brzezinska, Jerzy Kolodziejski and Jan Lesinski, Warsaw]

[Text] Miscroprocessor systems feature a relatively high versatility due to their flexible software. However, makers of semiconductors manufacture various kinds of integrated circuit-based microprocessor systems geared to specific applications or groups of applications. The MOS and CMOS technologies are predominant. Biolar techniques are utilized in all cases where higher operating speed is required, or when it is easier to attain the desired logical levels or power. Consequently, commercially available are both complete bipolar microprocessor systems (e.g. the modular 2-bit 3000 system of the firm of INTEL, and the modular 4-bit AMD 2900 system of the firm of Advanced Micro-Devices incorporating TTL S circuits, the XC 10800 system of the firm of Motorola with ECL circuits, the SBP0400 of the firm of Texas Instruments with I^2L circuits, and also the fully independent peripheral (auxiliary) circuits for microprocessor systems provided with a central processing unit (CPU) realized in the MOS technology. An example in this case is provided by the 8- and 16-bit microprocessor systems MCS 80 and MCS 86 of the firm of Intel. These incorporate the TTL S bipolar circuits cooperating directly with the CPU or serving as an interface for peripheral devices. Similar functions are performed by the developed in Poland bipolar microprocessors TTL SIC's of the UCY74S N series (see the Table listing).

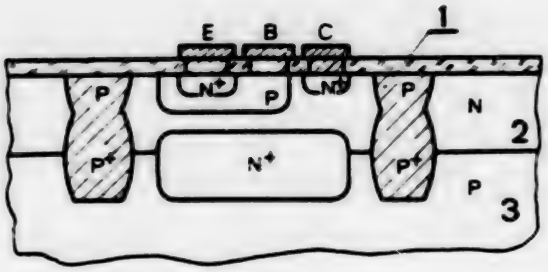
A transistor with a Schottky's diode connected between the base and the collector is the basic component ensuring high speed operation of the TTL S circuits. Principle of that diods's operation consists in the existence of a surface barrier between the silicon and the metal. Consequently, the manufacture of Schottky's diodes is a characteristic feature of the TTL S circuit technology. This operation requires an adequate preparation of the surface of the silicon and its subsequent coating with a layer of aluminium or another metal (e.g. platinum), and the formation of a potential difference barrier.

The discussed group of UCY74S digital circuits features an increased density of packing the components in comparison with the standard medium-scale integrated circuits (MSI). This has been attained, while preserving the epitaxial layer thickness at a level typical of TTL S MSI digital circuits, by the application of a special technique of manufacturing the isolation of circuit components. This technique involves the formation of p^+ layers besides the n^+ burried layers in the silicon substrate.

Table: Specifications of bipolar microprocessor systems

Polish symbol	Equivalent			Function	Output type	Housing (number of output terminals)	Applications
	INTEL	T.I.	NEC				
UCY74S405N	8205	SN74S138		Decoder 1 out of 8	Totem pole	16	Universal decoder 1 out of 8
UCY74S412N	8212		8212	8-bit I/O port with a monitoring and control circuit	Totem pole three-state	24	8-bit microprocessor system, and others
UCY74S414N UCY74S416N	8214		8214	Interruption controller	O.C., totem pole	24	8-bit microprocessor system
	8216		8216	4-bit bi-directional buffer of system bus	Three-state	16 (with an internal radiator)	Universal 4-bit buffer for 4, 8- and 16-bit systems
UCY74S424N	8224	SN74LS424	8224	Clock generator for JC MCY7880	Totem pole (MOS and TTL levels)	16 (with an internal radiator)	8-bit system sith JC MCY7880 (equivalent to 8080A of the firm of INTEL)
UCY74S426N	8226		8226	4-bit bi-directional buffer of system bus with negation	Three-state	16 (with an internal radiator)	— Universal 4-bit buffer for 4-, 8- and 16-bit systems
UCY74S428N	8228	SN74S428	8228	System controller with JC MCY7880	Totem pole	28	8-bit system with JC MCY7880 (equivalent to 8080A of the firm INTEL)
UCY74S438N	8238		8238	System controller with JC MCY7880 for larger systems	Totem pole	28	8-bit system with JC MCY7880 (equivalent to 8080A of the firm INTEL)
*UCY74S482/ /83N	8282/83		8282/83	8-bit bistable element of "latch" type	Three-state	20	16- and 8-bit microprocessor systems, and other systems
*UCY74S486/ /78N	8286/87		8286/87	8-bit line transmitter/ /receiver /transceiver/	Three-state	20	(ibid.)

* in development O.C. — open collector



A crossection of a transistor in a double-isolation integrated circuit: 1 — isolation, 2 — epitaxial layer, 3 — substrate

The p^+ layers then make it possible to conduct from both directions the diffusion of insulation in the epitaxial layers, i.e. from the substrate ("from the bottom") and from the upper surface of the water (Fig.).

A patent application concerning this technique has been filed with the Polish Patent Office.

Application of that technique involves the reduction of lateral diffusion, which in turn allows the acceptance of more stringent design requirements and leads to increased packaging density of circuit components.

The good quality of the UCY74S series bipolar microprocessor circuits is ensured by intensive measurements and testing.

Measurements on the integrated circuits are performed by means of large, computerized measuring testers. Tests foreseen by the measuring routines cover:

— testing of contacts (a standard test eliminating completely the faulty circuits),

— functional testing (for small circuits such as the UCY74S405N the testing involves checking up of all possible combinations of input logical states; for large ones, such as UCY74S428N, the testing involves the simulation of operation in microprocessor system),

— the measurement of input and output currents and voltages (among other things, the output load carrying capabilities).

Besides these measurements, the dynamic parameters of the circuits (switching times) are also being checked up.

Sets of such tests ensure not only a correct operation of the circuits, but also the maintenance of adequate safety margins when designing complex microprocessor systems.

Each integrated circuit is tested at least twice: during wafer (probe) measurements, when the circuit is in the shape of a structure on a silicon wafer, and during final measurements performed on hermetically sealed circuits.

The final measurements cover all parameters guaranteed by the maker, and also certain supplementary tests.

Reliability of circuits is tested according to the Polish Standard Specification (PN), and besides the mechanical and climatic tests (they check the correctness of connections and hermetization, etc.). These reliability tests also cover the resistance to elevated temperatures and long-lasting electric loads. The latter test in particular ensures reliable operation of the integrated circuit at the user. This test is performed at an elevated temperature and in an electrical circuit resembling a real application system.

The discussed UCY74S series microprocessor systems have been developed at the Institute of Electron Technology (ITE), and are manufactured by the TEWA Semiconductors' Factory, both institutions belonging to the CEMI Scientific and Production Centre for Semiconductors, Warsaw.

CSO: 2020/22

POLAND

SCIENTIFIC COMMUNITY CRITICIZES ECONOMIC REFORM

Warsaw RZECZPOSPOLITA in Polish 9 Feb 83 pp 1, 3

/Interview with Aleksander Kopec, PhD, president of NOT Main Technical Organization by Tadeusz Podwysocki: "Technical Cadres Versus the Reform"; date and place not specified/

/Text/ Scientific and technical personnel constitutes currently an important socio-occupational group with enormous influence on science, technology and the economy. Several months ago, in October 1982, a Congress of Polish Technologists was held in Lodz. What is being done now with the congress's resolutions? The federation of scientific and technical associations has recently been vigorously joining at its various levels the movement for national consensus. We asked NOT president Aleksander Kopec to comment on these subjects.

/Question/ The congress was held, and then silence followed, as if merely another gala show at Lodz opera was at issue. This is the impression many people have.

/Answer/ Sure, people's judgments differ, and everybody has the right to formulate his own views. The ones that should be accepted for the purposes of practical activity are genuine views that are acceptable by a decisive majority, and those are completely different from the assessments which you mentioned in your question. The technical community came to the congress with distrust, somewhat suspicious and divided, and left united, with a great dose of optimism and hope, and with an operational program adopted virtually unanimously. These feelings and perceptions are true and close to the heart of the technical community.

Above all, it should be realized that the 20th Congress of Polish Technologists was held during a very difficult sociopolitical period. It was the largest social event during the period of martial law. Let us not forget that it was attended by nearly 1,700 persons from all of Poland, including 1,200 delegates elected by secret ballot who had been, therefore, the most popular representatives of the community.

The congress was taking place under the conditions of an imbalanced socioeconomic situation. Under those difficult circumstances, the technical community demonstrated its patriotic attitude, civic discipline and a willingness to serve the ideas of socialism and the socialist state. It demonstrated its respect for the political governance in the country. These are the historical enduring attitudes and values of the technical community. Fully aware of the continuity of historical traditions, the community articulated its willingness to participate actively in the country's life during processes of stabilization and emergence from the crisis.

/Question/ The heart of the matter at this time, I believe, is in making good use of the proposals offered by scholars, engineers and technicians which can give a boost to our economy. Many such proposals correctly addressing specific points were offered during the congress. This brings me back to the statement that we can no longer settle for a gala show, as was the case with previous congresses.

/Answer/ For now, the fundamental issue is to put congress stipulations into being. The weak point of all previous congresses was indeed a paternalistic attitude with respect to their resolutions. We are now striving for a businesslike attitude to evolve within the political and state authorities and the community itself, regarding the motions of the 20th Congress. This is a major substantive change in the style of operation and in attitudes within our community.

We have invited representatives of interested ministries jointly to develop an implementation schedule for congress resolutions, a realistic one, rather than remote from the possibilities of the economy, the state, and society's life. We have also addressed the government with a request to consider several important issues. Our concern is with the form of collaboration between the scientific-technical community and the authorities as well as with the problems of professional specialization and wage system for the creative cadre, engineers, technicians and managers. We addressed the authorities with a motion on the urgent need to institute a state body to direct scientific technological progress on a national basis and with proposals to modify certain econoomic-financial mechanisms under economic reform. We have established a committee for implementation of congress resolutions.

/Question/ There has been no such venerable body in the past.

/Answer/ A committee of this kind was appointed for the first time. We will consistently and systematically follow and monitor implementation of congress resolutions and motions proposed in the debate. The committee's goal is to influence actively our community, stimulate initiatives fostering implementation of stipulations offered by the congress of Polish technicians. We expect that this activity will bring our organization tangibly closer to the expectations of the community.

/Question/ An opinion is being circulated that the technical cadre shuns economic reform, dislikes it, sees no room for itself under the reform, and even negatively assesses the assumptions of the new economic policy.

/Answer/ The charge is fabricated, untrue, and divorced from the realities of economic life. After all, the Lodz congress and year-long preparatory work, clearly intensifying professional activity levels in the community, had social and economic reinvigoration as their goals, and they performed their role. The congress was followed by the first evident economic jolt. Industrial production started to increase quite substantially in certain sectors, which is unequivocally connected with the work of engineers, technicians, and employee collectives. It is the best testimony to the technical engineering personnel being the vanguard in instituting economic reform. If we see certain deficiencies of the reform and emphasize them, occasionally taking positions with perhaps too much emotion, it is only because our community is the closest to the working class and desires to have realistic, tangible and, as much as possible, immediately felt effects from the reform.

/Question/ It is difficult to deny, however, that there is a difference in views between economists and technicians, concerning the form and method of implementation of the reform.

/Answer/ Time has done its job. Early last year, the differences between the technical community and the economic community were very large. Gradually, those differences have been reduced. They are considerably smaller at this time.

/Question/ I recall that during a congress of economists at Warsaw's Victoria Hotel claims were made that the position of NOT was a downright oddity as an example of argument against economic reform.

/Answer/ Differences of opinion affected many issues at the time. We took the position that the reform should have been started from the bottom, from enterprises up, rather than down from the top of management. We believed that a reform should begin with the establishment of conditions permitting increases in labor productivity and the instituting of labor discipline. We believe that a reform should set up favorable conditions for intensive factors of growth, including scientific and technological progress, labor productivity, quality of workmanship and structural modifications in the national economy. Economic-systemic considerations are a noticeable step forward, but it is an inadequate step. The failure to move ahead, both theoretically and in economic practices, during the first year of implementation of a reform which is considered to be exceptionally profound and even comprehensive, bears witness to the lack of confidence in the causal factors inherent in scientific-technological progress.

/Question/ The most recent GUS /Main Statistical Office/ reports are more than alarming: labor productivity expressed in terms of production sold per one employee was by a full 10 percent lower last year than in 1979. On this issue, therefore, technical specialists were correct.

/Answer/ Currently, the scientific-technical community is greatly disturbed by certain economic-financial solutions, e.g., those adopted in wage systems and price setting. Though other factors are also present, these solutions result from the situation that industrial production in 1982 decreased by

2 percent, and national income by much more, whereas the wage fund expended on that reduced production rose by nearly 50 percent, and the average wage by even more. This clearly affirms the claim that there is some ineffectiveness and imperfection in the adopted economic-financial solutions. They are incompatible with the sociopolitical conditions that were in existence during the past year. If continued, this course will be equivalent to superinflationary economic developments, resulting in declining standard of living and disarray of public life.

Many current discussions concerning materials-intensiveness and energy-intensiveness of national income will end with the finding that those ratios are worse than they were in the past. The reason is that the very essence of planning inherently contains no structural changes as a factor of intensive economic growth or economic efficiency. This is, precisely, the major defect resulting from applications of scientific advances to systems-type solutions and practical requirements.

/Question/ I have long been in favor of the view that a joint platform of operation must be developed for economists and technical specialists, for the sake of the country's interests and contrary to parochial and professional ambitions.

/Answer/ Of course. After all, this is neither a structural conflict nor a conflict between the communities, it simply represents a separate, dissimilar point of view on substantive issues, centered on different perception of the same phenomena. Such differences, in fact, are decreasing.

Currently, a sizeable segment of the economic community shares our views, being closer to our position on reform than earlier. Add here, however, that we have never propounded the thesis that the reform should be introduced on the ruins of yesterday's economy, while numerous--even well-known--economists did propose to erect a new economy and a new economic system on the detritus of the old one. The engineering community never shared such views and, because of its matter-of-factness, it was unpopular in the recent past.

/Question/ Economic reform regards scientific-technological progress as secondary factor. This is a source of bitterness among scientific and technical specialists. Up to now, the federation of their associations has not shown sufficient penetrating force on this issue.

/Answer/ This is true. We discussed this at the Lodz congress. We notice today that scientific-technological progress was not placed in gear with the mechanisms of the reforms, which is contained within the economic-financial and banking systems. On the other hand, the reform virtually leaves the entirety of scientific-technological progress on the side. This cannot be continued over the long-term. This condition should not last much longer. Every experienced economic activist knows that science and technology are the source of progress. They must be involved in the flow of economic life. Hence comes engineers' and technicians' distrust of the reform, especially as its far-reaching goals and effects are concerned.

We have taken and we maintain the position that scientific-technological progress should be turned into a factor of intensive economic development. In our opinion, structural and organizational changes in the economy should become a factor that intensifies, rather than halts the processes of Poland's emergence from the crisis. We also take the position that science should be more broadly incorporated into programming, planning implementation of tasks and stabilization of the economy. This was never achieved in the past despite the many pronouncements made, and now too this element of the strategy has not been precisely formulated. These important issues cannot be left out or overlooked. They must be taken up and solved.

/Question/ The country needs enlightened collective action for the sake of unity and consensus. Engineers and technicians are a substantial group of people with distinct prestige and social standing. Their share in this action is of major significance.

/Answer/ Regardless of differences in individual world-views and in political beliefs, the scientific-technical community took a stand for consensus and national compromise. We are a good example of collaboration among people with different or opposing views: a majority has always decided about our directions for action, which well exemplifies the functioning of community democracy. We are united by scientific and technical creative process, the process of production and organization of work and varied forms of collegial interaction. Individual outlooks are respected in our community, as they enrich the forms of our work, but they take secondary importance whenever fundamental assessments are at issue. Such concerns as the country, state and society integrate the community as an important segment in the national consensus.

Hence, in the difficult years 1981-82, our community--as a totality--never questioned the ideas of socialism and the constitution, nor stepped out against the state and the authorities. We have always been for law and order. The ideas of national consensus which are now taking on a new form are an expression of the views we have voiced for many years. This is why many associations, e.g., chemists, miners and improvement originators, declared a long time ago their collective participation in the movement for national understanding.

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